



ADC Commercialisation Bulletin #13

PAPAIN

Marketing

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Markets

Papain is a proteolytic enzyme that tenderises meat and can act as a clarifying agent in many food industry processes. It is a common ingredient in brewery and meat processing. Although synthetic substitutes are available at lower cost, the demand for papain is still strong as a food ingredient since it is perceived as a natural product.

2

Customers

Papain is purchased and distributed by specialist food ingredient companies mainly in Europe and the US and redistributed to many other countries. The number of companies involved in primary purchase is relatively small and all have their traditional sources. Before investing in papain it is therefore essential to obtain a contract from at least one of them. Furthermore since quality particularly the enzyme activity of extracted papain, varies tremendously, it is essential to agree a specification on the type of papain to be supplied.

3

Volumes

Exact volume figures are not reported in official government trade statistics. However, based on overall trade figures for enzymes from major producing countries, trade has been expanding over years.

Total market size in Europe is estimated at several hundred tons per year. The European papain market has continued to remain steady, with small fluctuations in supply from the producing countries. Several plantations that were established during the papain shortage in the early 1990s are just beginning to produce, which has created more available supply for European and US markets. Demand for papain from breweries is declining as cheaper and more readily available substitutes are being used to emulate papain's function. There have also been health concerns with papain's use in beer. Several brewers who switched to papain substitutes during a shortage in the early 1990s never went back to it when supplies picked up. Papain use, however, has continued to expand in the food industry, supporting the increase in volume.

The US market has been estimated at up to double the EU market or roughly 300 to 400 Mts per year. Trade volumes of papain into the US continue to be steady as well. One importer expressed concerns that papain may be substituted by cheaper alternatives in the future. Importers stated that weather problems as well as political and economical issues in supplying countries would continue to affect the supply, making it difficult to assume that the world papain market will remain steady.

The Japanese market is considered relatively small at under 50 Mts per year.

Exports from Uganda were reported by customs to be 223 tonnes in 1996, which is equivalent to a market share of about 25 percent. Although some is produced in Uganda, much of this papain probably originates from the DRC, which is traditionally a major supplier to the world market.

4

Prices

Prices for papain in Europe continued to fall through June 1999, although the decreases were less dramatic than in previous years. The decrease in price can be attributed to greater quantities of papain available to import markets. Importers are not optimistic that prices will flatten out considering the fluctuations in price over the past decade. Prices for papain increase with its TU measurement, although one importer noted that prices for higher grades of papain are proportionally cheaper. One buyer quoted prices for 70 TU papain ranging from US \$ 12 - 14 per kilogram and has seen 700 TU papain sold for as low as US \$ 40 per kilogram.

The US has been affected by increasing papain supplies in a similar fashion. Prices for papain have been quoted as low as US \$ 10 per kilogram and as high as US \$ 80 per kilo for papain with a high TU measurement. Most of the US buyers surveyed reprocess their imports according to the buyers' specification.

Ugandan firms buy papain flakes at US \$ 12 - 20/ kg from Congo, although the usual is around US \$ 12 - 15/kg.

5

Competition

African nations, particularly the DRC, are major exporters of papain. Other suppliers include Australia, India, and Sri Lanka. Many importing countries, particularly Japan, several in Europe and the United States, further process their papain imports and re-export the finished product amongst themselves and to others.

Direct imports into the US are mostly sourced from India, with smaller supplies coming from China, the Congo, and Indonesia.

Production

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Method

Harvesting the Latex. The latex is collected from the oldest, yet still green, fruits. The best collection time is during the morning on misty/cloudy days or after a rain. The best seasonal time is when there are both warm temperatures and high humidity. Make three vertical incisions in the lower sections of each fruit (tap fruit layer by layer) and collect the latex in a collection bag. Trays or other containers can also be used. All equipment should be clean to prevent the contamination of the latex with foreign matter. The latex must be quickly processed or it will start to lose its enzymatic activity.

Processing. Sun drying of latex produces the lowest grade powder (cream-brown in color), with the lowest activity. Higher quality papain flakes can be produced in Uganda with low cost locally made equipment. To produce papain flakes, latex normally is dried in batches of at least 500 kilograms (which will produce 50 kg of

flakes). First, the latex is whisked in a tank to produce a homogenous liquid. The liquid is then filtered through muslin (raw cotton) to remove waxy components. The liquid is then poured onto shallow trays which are placed in a drying house. Dry at 60°C for 3 to 4 days or until flakes are dry. Oven drying after filtration will produce a lighter color powder or flake with a higher activity level than produced by sun drying.

More advanced processing options involve spray drying. The latex is filtered and centrifuged to produce a 45% solid concentration. A white to cream coloured powder is produced with two to three times the activity levels of

The papain powder or flake may be further purified in the importing country.

Papain loses its strength relatively quickly, particularly if not stored under cool conditions. A loss of enzyme activity will mean a reduction in price. Contact with air and metals should also be avoided. Therefore, papain should be sent relatively quickly to the buyer.

7

Varieties

Papaya grown for papain should have high fruit and latex yields as well as a high level of enzymatic activity. Female plants reportedly yield two times more papain than hermaphrodite plants, although a farm should have some male plants for pollination.

During 1995-1997, the ADC in conjunction with a commercial processor evaluated papaya genotypes to determine those most suitable for papain production. The research concluded that a locally selected genotype MB8 was most suitable for papain production in terms of fruit and latex yield, followed by MB11 and MB10². All three genotypes also had high Brix readings and enzymatic activity. The genotypes had been obtained from Mukono and Mpigi districts in 1994.

8

Yield

Based on ADC/IDEA project trials at Mubuku, latex yield should be at least 650 kg/acre. Latex to papain flake yield ratio is generally ten to one. Therefore, one acre of production in Mubuku should yield approximately 65 kg of papain flakes.

9

Time to First Harvest/Seasonality

Production of green papaya fruit starts about 10 months from transplanting. Fruit is usually tapped for latex 75 to 90 days after fruit set. An oven drying operation takes about 3 to 4 days.

10

Product Specifications

Papain is sold in both liquid and powdered form. It is commonly imported in a raw form and processed according to the end users' specifications. The strength of papain is measured in Tyrosine Units (TU). According to one papain dealer in the UK, 70-75 TU liquid papain is commonly used by breweries. However, some buyers require

strengths of up to 500-700 TU.

One of the biggest problems for papain buyers is low enzyme activity, usually caused by storing latex for more than a day while sufficient stock is accumulated to start processing.

11 Packaging

Plastic containers are normally used to pack crude papain powder/flakes, as metal containers will cause a loss of enzyme activity. If possible, flush the container with an inert gas to remove oxygen. The plastic containers are often put into a tight cardboard container. More highly purified papain may be packed in 10 kg to 50 kg fibreboard drums that have been lined with polyethylene.

Investment

12 Cost of Production

The major costs of production are shown in Table 2. These include: ploughing, labor (seed collection, nursery management, slashing, planting, clearing field ditches, spraying, fertiliser application, irrigation, weeding, and harvesting), fertilizers, chemicals, processing, and miscellaneous charges. The total cost of production is estimated at Ushs 454,200/acre.

13 Profitability

A Ugandan producer of papain flakes can expect a gross margin of Ushs 325,800 per acre. See Table 2.

Table 2: Projected Gross Margins for Ugandan Producer of Papain Flakes
(Ushs/acre)

Revenue		
Yield ¹ (kgs/acre)	65	
Sales Price (Ushs/kg)	12,000	
Total Revenue		780,000
Expenses		
Seed/Plants ²	2,000	
Land Cultivation ³	50,000	
Fertiliser ⁴	100,000	
Chemicals ⁵	72,000	
Labour ⁶	137,700	
Stakes etc	30,000	

Processing ⁷	61,500	
Packaging	<u>1,000</u>	
Total Expenses		<u>454,200</u>
GROSS MARGIN		325,800

¹ The yield is based on a 10:1 recovery rate of papaya flakes from latex. Based on ADC/IDEA trials, the likely Ugandan yield of latex per acre is 650 kg/acre.

² Collected by the farmer at Ushs 2,000/acre.

³ Two times tractor ploughing @ Ushs 25,000 each.

⁴ 4 bags of NPK @ Ushs 25,000 each.

⁵ 3 kgs of fungicides + 3 litres of insecticides @ Ushs 12,000 per litre or kg.

⁶ nursery management (Ushs 15,000 for 21 days); slashing (Ushs 10,000/acre); planting (Ushs 4,200, 14 ridges @ Ushs 300/ridge); clearing field ditches (Ushs 6,000, 2 times @ Ushs 3,000); spraying (Ushs 7,500, 5 man days @ Ushs 1,500/day); irrigation (Ushs 20,000/acre); weeding (Ushs 15,000, 10 man days @ Ushs 1,500/day); harvesting (Ushs 45,000, 30 man days @ Ushs 1,500/day)

⁷ Drying (Ushs 22,500; 15 man days @ Ushs 1,500/day); Miscellaneous (5 percent of revenue, total UShs 39,000/acre).

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Investment Requirements

Smallholder: Investment for a papaya grower that harvests latex will be minimal: incisors, collection trays, plastic buckets, and wooden scrapers.

Processor. Investment requirements for a small oven drying operation in Uganda would not exceed US\$10,000 for construction of a small building and the purchasing of a tank, oven, drying trays, and other miscellaneous equipment. This size operation could process approximately 500 kilograms of latex every 3 to 4 days, producing 50 kilograms of papain flakes.

More Information

Additional information on papaya and papain production, postharvest handling, and marketing is available from ADC/IDEA, including:

Uganda: Production of Papain Enzyme and Fresh Papaya Fruits for Export. International Trade Centre UNCTAD/GATT, Geneva. 1984. 77 pages.

Identification and Evaluation of Improved Papaya Genotypes for Papain Production. National Agricultural Research Organisation, Entebbe. 1997. 22 pages.

ADC Commercialisation Bulletins are published by the Agribusiness Development Centre of the USAID-funded Uganda's Investment in Developing Export Agriculture (IDEA) Project. The bulletins provide potential investors with a quick reference to production and market characteristics for various high-value export crops. For additional technical details, contact:

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